

What Is Claimed Is:

1 1. A transflective liquid crystal display (LCD) device
2 with a single cell gap, comprising:
3 a first substrate and a second substrate opposite thereto,
4 wherein the transflective LCD device comprises a
5 reflective region and a transmissive region;
6 a plurality of first pixel electrodes and a plurality of
7 second pixel electrodes on the first substrate, the
8 first pixel electrodes in the reflective region and
9 the second pixel electrodes in the transmissive
10 region;
11 a plurality of first common electrodes and a plurality of
12 second common electrodes on an inner surface of the
13 second substrate, the first common electrodes in the
14 reflective region and the second common electrodes
15 in the transmissive region;
16 a vertically aligned liquid crystal layer interposed
17 between the first substrate and the second
18 substrate, wherein orientation of the vertically
19 aligned liquid crystal layer is controlled by an
20 electric field between the pixel and common
21 electrodes;
22 a first orientation control window having a slit width
23 " S_{rc} " between the first common electrodes in an area
24 corresponding to each first pixel electrode and
25 dividing the liquid crystal layer into a plurality
26 of orientation sections; and
27 a second orientation control window having a slit width
28 " S_{tc} " between the second common electrodes in an area

29 corresponding to each second pixel electrode and
30 dividing the liquid crystal layer into a plurality
31 of orientation sections;
32 wherein a relationship between S_{rc} and S_{tc} satisfies
33 $S_{rc} < S_{tc}$.

1 2. The transflective LCD device according to claim 1,
2 wherein each first common electrode comprises an electrode
3 width " W_{rc} " and each second common electrode comprises an
4 electrode width " W_{tc} ", and a relationship between W_{rc} and W_{tc}
5 satisfies $W_{rc} < W_{tc}$.

1 3. The transflective LCD device according to claim 1,
2 further comprising:
3 a first opening having a slit width " S_{rp} " between the first
4 pixel electrodes in an area corresponding to each
5 first common electrode; and
6 a second opening having a slit width " S_{tp} " between the
7 second pixel electrodes in an area corresponding to
8 each second common electrode;
9 wherein a relationship between S_{rp} and S_{tp} satisfies
10 $S_{rp} < S_{tp}$.

1 4. The transflective LCD device according to claim 2,
2 wherein each first pixel electrode comprises an electrode width
3 " W_{rp} " and each second pixel electrode comprises an electrode
4 width " W_{tp} ", and a relationship between W_{rp} and W_{tp} satisfies
5 $W_{rp} < W_{tp}$.

1 5. The transflective LCD device according to claim 1,
2 wherein the slit width " S_{rc} " of the first orientation control
3 window ranges from $3\mu\text{m}$ to $7\mu\text{m}$.

1 6. The transflective LCD device according to claim 1,
2 wherein the slit width " S_{tc} " of the second orientation control
3 window ranges from $8\mu\text{m}$ to $12\mu\text{m}$.

1 7. The transflective LCD device according to claim 2,
2 wherein the electrode width " W_{rc} " of each first common electrode
3 ranges from $5\mu\text{m}$ to $15\mu\text{m}$.

1 8. The transflective LCD device according to claim 2,
2 wherein the electrode width " W_{tc} " of each second common
3 electrode ranges from $15\mu\text{m}$ to $25\mu\text{m}$.

1 9. The transflective LCD device according to claim 3,
2 wherein the slit width " S_{rp} " of the first opening ranges from
3 $3\mu\text{m}$ to $7\mu\text{m}$.

1 10. The transflective LCD device according to claim 3,
2 wherein the slit width " S_{tp} " of the second opening ranges from
3 $8\mu\text{m}$ to $12\mu\text{m}$.

1 11. The transflective LCD device according to claim 4,
2 wherein the electrode width " W_{rp} " of each first pixel electrode
3 ranges from $5\mu\text{m}$ to $15\mu\text{m}$.

1 12. The transflective LCD device according to claim 4,
2 wherein the electrode width " W_{tp} " of each second pixel electrode
3 ranges from $15\mu\text{m}$ to $25\mu\text{m}$.

1 13. The transflective LCD device according to claim 1,
2 further comprising a gap " d " between the pixel and common
3 electrodes, ranging from $3\mu\text{m}$ to $5\mu\text{m}$.

1 14. The transflective LCD device according to claim 1,
2 wherein configuration of the first orientation control window
3 and the second orientation control window is a straight striped
4 pattern.

1 15. The transflective LCD device according to claim 1,
2 wherein configuration of the first orientation control window
3 and the second orientation control window is a wedge-shaped
4 pattern.

1 16. The transflective LCD device according to claim 1,
2 further comprising:
3 an insulating layer on the first substrate;
4 a reflective layer on the insulating layer in the
5 reflective region; and
6 a transparent planarization layer on the reflective layer
7 and the insulating layer;
8 wherein a top surface of the insulating layer in the
9 reflective region is higher than that in the
10 transmissive region.

1 17. The transflective LCD device according to claim 1,
2 further comprising:
3 an insulating layer on the first substrate;
4 a reflective layer on the insulating layer in the
5 reflective region; and
6 a color filter on the reflective layer and the insulating
7 layer;
8 wherein a top surface of the insulating layer in the
9 reflective region is higher than that in the
10 transmissive region.

1 18. The transflective LCD device according to claim 3,
2 wherein S_{rc} equals S_{rp} and S_{tc} equals S_{tp} .

1 19. The transflective LCD device according to claim 4,
2 wherein W_{rc} equals W_{rp} and W_{tc} equals W_{tp} .

1 20. The transflective LCD device according to claim 3,
2 wherein the first orientation control window faces a center
3 part of each first pixel electrode, the second orientation
4 control window faces a center part of each second pixel
5 electrode, the first opening faces a center part of the first
6 common electrode and the second opening faces a center part of
7 the second common electrode.

1 21. A method of fabricating a transflective liquid
2 crystal display device, comprising the steps of:

3 providing a first substrate and a second substrate
4 opposite thereto, wherein the transflective LCD
5 device has a reflective region and a transmissive
6 region;

7 forming a reflective layer overlying the first substrate
8 in the reflective region;

9 forming a transparent planarization layer or a color
10 filter overlying the reflective layer and the first
11 substrate;

12 forming a plurality of first pixel electrodes and a
13 plurality of second pixel electrodes on the
14 transparent planarization layer or the color
15 filter, wherein the first pixel electrodes are
16 located in the reflective region and the second
17 pixel electrodes in the transmissive region;

forming a plurality of first common electrodes and a plurality of second common electrodes on an inner surface of the second substrate, wherein the first common electrodes are located in the reflective region and the second common electrodes in the transmissive region; and

filling a space between the first substrate and the second substrate with liquid crystal molecules to form a vertically aligned liquid crystal layer interposed between the first substrate and the second substrate, wherein orientation of the vertically aligned liquid crystal layer is controlled by an electric field between the pixel and common electrodes;

wherein a first orientation control window having a slit width " S_{rc} " is formed between the first common electrodes in an area corresponding to each first pixel electrode, dividing the vertically aligned liquid crystal layer into a plurality of orientation sections;

wherein a second orientation control window having a slit width " S_{tc} " is formed between the second common electrodes in an area corresponding to each second pixel electrode, dividing the vertically aligned liquid crystal layer into a plurality of orientation sections;

wherein a relationship between S_{rc} and S_{tc} satisfies $S_{rc} < S_{tc}$.

1 22. The method according to claim 21, wherein each first
2 common electrode has an electrode width " W_{rc} " and each second
3 common electrode an electrode width " W_{tc} ", and a relationship
4 between W_{rc} and W_{tc} satisfies $W_{rc} < W_{tc}$.

1 23. The method according to claim 21, further comprising
2 the steps of:

3 forming a first opening having a slit width " S_{rp} " between
4 the first pixel electrodes in an area corresponding
5 to each first common electrode; and

6 forming a second opening having a slit width " S_{tp} " between
7 the second pixel electrodes in an area corresponding
8 to each second common electrode;

9 wherein a relationship between S_{rp} and S_{tp} satisfies

10 $S_{rp} < S_{tp}$.

1 24. The method according to claim 22, wherein each first
2 pixel electrode has an electrode width " W_{rp} " and each second
3 pixel electrode an electrode width " W_{tp} ", and a relationship
4 between W_{rp} and W_{tp} satisfies $W_{rp} < W_{tp}$.

1 25. The method according to claim 21, wherein the slit
2 width " S_{rc} " of the first orientation control window ranges from
3 3 μ m to 7 μ m.

1 26. The method according to claim 21, wherein the slit
2 width " S_{tc} " of the second orientation control window ranges from
3 8 μ m to 12 μ m.

1 27. The method according to claim 22, wherein the
2 electrode width " W_{rc} " of each first common electrode ranges from
3 5 μ m to 15 μ m.

1 28. The method according to claim 22, wherein the
2 electrode width " W_{tc} " of each second common electrode ranges
3 from 15 μ m to 25 μ m.

1 29. The method according to claim 23, wherein the slit
2 width " S_{rp} " of the first opening ranges from 3 μ m to 7 μ m.

1 30. The method according to claim 23, wherein the slit
2 width " S_{tp} " of the second opening ranges from 8 μ m to 12 μ m.

1 31. The method according to claim 24, wherein the
2 electrode width " W_{rp} " of each first pixel electrode ranges from
3 5 μ m to 15 μ m.

1 32. The method according to claim 24, wherein the
2 electrode width " W_{tp} " of each second pixel electrode ranges from
3 15 μ m to 25 μ m.

1 33. The method according to claim 21, wherein a gap " d "
2 is formed between the pixel and common electrodes, ranging from
3 3 μ m to 5 μ m.

1 34. The method according to claim 21, wherein
2 configuration of the first orientation control window and the
3 second orientation control window is a straight striped
4 pattern.

1 35. The method according to claim 21, wherein
2 configuration of the first orientation control window and the
3 second orientation control window is a wedge-shaped pattern.

1 36. The method according to claim 21, wherein the common
2 electrodes are ITO (indium tin oxide) or IZO (indium zinc oxide)
3 layers.

1 37. The method according to claim 21, wherein the pixel
2 electrodes are ITO (indium tin oxide) or IZO (indium zinc oxide)
3 layers.

1 38. The method according to claim 21, wherein the
2 reflective layer is an aluminum or silver layer.

1 39. The method according to claim 21, wherein the
2 transparent planarization layer is a SiO₂ layer.

1 40. The method according to claim 21, wherein the liquid
2 crystal molecules are negative type ($\Delta\epsilon < 0$).

1 41. The method according to claim 23, wherein S_{rc} is equal
2 to S_{rp} and S_{tc} equals S_{tp} .

1 42. The method according to claim 24, wherein W_{rc} is equal
2 to W_{rp} and W_{tc} equals W_{tp} .

1 43. The method according to claim 23, wherein the first
2 orientation control window faces a center part of each first
3 pixel electrode, the second orientation control window faces
4 a center part of each second pixel electrode, the first opening
5 faces a center part of the first common electrode and the second
6 opening faces a center part of the second common electrode.

1 44. The method according to claim 21, wherein an
2 insulating layer is formed on the first substrate before
3 forming the reflective layer and a top surface of the insulating

Client's ref.: Hannstar-A03011/張靜潮
File:0611-9879USF/Jacky/Kevin

- 4 layer in the reflective region is higher than that in the
- 5 transmissive region.